SPECIAL REPORT

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What is the association between clear corneal cataract incisions and postoperative endophthalmitis?

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The relationship between unsutured clear corneal tunnel incisions and an increased incidence of infection after cataract surgery remains uncertain; however, there is a growing concern and body of evidence regarding a potential causal association. Although 2 large recent studies from the Bascom Palmer Eye Institute report no greater incidence of endophthalmitis with corneal incisions than with sclerocorneal tunnel incisions,[1,2] the bulk of the recent literature suggests that post-cataract endophthalmitis is more likely with corneal incisions (Table 1).[3–6] The concern is fueled by the clear evidence of an increased rate for post-cataract infections since 1994, the timeline for the widespread use of unsutured clear corneal cataract incisions.[7] Indeed, laboratory models indicate that corneal tunnel incisions do not provide hermetic sealing under certain conditions.[8–10] These investigations suggest that the incisions may be competent at physiologic levels of intraocular pressure (IOP) but fail when IOP is lowered.

Critics of the reports, in which human cadaver eyes are used, raise the valid issue that post-mortem eyes lack the corneal endothelial pump mechanism thought to be partly responsible for maintaining incisional self-sealing. Nonetheless, there is a genuine concern regarding the relationship between clear corneal incisions (CCIs) and rates of postoperative infection, suggesting that we carefully evaluate the potential. A recent report in this journal[11] revealed that all cases of endophthalmitis at the Moran Eye Center at the University of Utah from 1996 through 2002 were associated with unsutured clear corneal incisions. During this period, in accord with the record review, no cases of infection were associated with sclerocorneal incisions.

POTENTIAL RISK FACTORS

What factors might account for a greater risk for infection after CCIs? One might consider the absence of an overlying, separate external conjunctival closure as potentially causal. However, this would imply that sclerocorneal incisions routinely have a meticulously and watertight conjunctival closure overlying the external aspect of the scleral tunnel; this is a seemingly unlikely scenario. Moreover, in virtually all anterior segment procedures, a clear corneal paracentesis is performed and there has generally been little to no association between well-constructed, small side-port incisions and increasing rates of postoperative infection, although a change from the traditional location may have some bearing, as discussed below. Furthermore, corneal transplantation requires a 360-degree CCI and rates of infection after corneal transplants are reportedly lower over the past decade.[12] Of course, corneal transplants are generally meticulously sutured.

If paracenteses and corneal transplants are at low risk for infection and clear corneal cataract incisions potentially present a higher risk for endophthalmitis, what factor(s) could account for this paradox? Wound architecture is the only logical answer. One theory suggests that ocular hypotony due to wound instability shortly after surgery allows corneal incisions to be deformed easily, inducing wound leak with further hypotony and a resultant pressure gradient from the outside in. This suggested pathway provides a portal for bacteria to contaminate the anterior chamber.

WOUND CONSTRUCTION

If deformation susceptibility is the putative mechanism, appropriate wound construction should be preventative.

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Table 1. Endophthalmitis rates.

Study*	Rates (%)
Taban[6]	
1970s	0.327
1980s	0.158
1990s	0.087
2000–2003	0.266
Clear cornea	0.189
Scleral tunnel	0.074
West[7]	
1994–1997	0.18
1998–2001	0.25
Eigrig[1]	
1995–2001	0.04
Miller[2]	
2000–2003	0.04
Clear cornea	0.05
Other	0.02
Nagaki[5]	
Temporal clear cornea	0.29
Superior scleral cornea	0.05
Colleaux[4]	
Clear cornea	0.129
Scleral tunnel	0.05

*First author of study

Ernest et al.[13] have convincingly demonstrated that cataract tunnel incisions that are square or nearly square in surface architecture are significantly more resistant to external deformation than those that are rectangular. In addition, the Langerman-style, deeply grooved preincision has been shown to resist deformation.[14] Nonetheless, no studies that support reduced rates of infection associated with these principles have been reported.

Construction of corneoscleral tunnel incisions generally includes careful and controlled dissection of the tunnel following a specific (and often marked) template. After tunnel dissection, the chamber is entered in clear cornea, creating the self-sealing valve. In this manner, the surgeon has the opportunity to construct an incision with predictable architecture. Clear corneal tunnel (and "near clear") incisions, by contrast, are fashioned with sharp (often gem) blades that create the tunnel and the chamber entry in a single motion. As a result, the surgeon tends to have less control over the configuration of the incision. This, added to the fact that corneal incisions originate more centrad than sclerocorneal incisions, contributes to rectangular rather than square surface architecture.

Several factors determine the length of the corneal tunnel; these include sharpness of the blade, IOP, thickness of the corneal tissue, and, perhaps most important, the angle of approach of the blade. Care must be taken by the surgeon to ensure that corneal tunnel incisions are constructed to match the concept of square surface architecture to exhibit adequate resistance to deformation. Width of the incision also comes into play as it is more onerous to work through a tunnel that is 3.5 mm square than one that is 2.5 mm square.

CORNEAL SEALING

Another concern regards (self) sealing of incisions. The cornea is less tolerant of stretching and distortion than the sclera. If the cataract incision is inadequate in width and subjected to stretching by surgical instrumentation, it is less likely to maintain its integrity. An entry wound that is too narrow and distorted during surgery will be more apt to leak than a modestly larger but less traumatized incision. This may also be true for bimanual microincision cataract surgery, as suggested by many surgeons and reported by Buratto and Giardini in 2004.[15] There is a logical concern that the unsleeved, rigid round tubes used for bimanual microphaco (irrigating choppers and phacoemulsification needles) may distort the small slit incisions used for bimanual cataract surgery, increasing the chances for a postoperative leak. Although the use of bimanual microincisions remains limited, determining that these microincisions are properly constructed and sealed in as meticulous a fashion as their "standard size" counterpart may be especially important.

It would seem, therefore, that incision design and construction play pivotal roles in the reported increased rates of infection with corneal tunnels, as poorly constructed and distorted wounds could contribute to a greater chance of postoperative anterior chamber contamination. Unfortunately, details of or standards for incision configuration are not offered in many studies that "incriminate" the CCI. In the future, one might consider methods to standardize the cataract incision to create architecturally consistent and truly self-sealing incisions. Biologic tissue adhesives continue to undergo refinement and may also serve to supplement wound closure. Research has shown that a biodendrimer adhesive can be as effective as a suture in sealing the wounds of enucleated human eyes.[16]

In the interim, surgeons who use corneal tunnels must pay particular attention to incision details and ensure proper sealing at the close of surgery; some establish IOP at physiologic levels and assess wound integrity with Seidel testing. Any incision suspected of incompetence (including side-port paracenteses) should be considered for suturing, bandage lenses, etc., as one study strongly emphasizes the relationship between incision leak and infection potential.[11] A well-placed suture, when needed, essentially divides the width of the incision in half, although sutures may distort tissue, induce transient astigmatism, and be

responsible for focal suture abscesses. Presently, to preclude the need for sutures, surgeons often use stromal hydration to enhance wound sealing, although the efficacy has not been fully established. Techniques for this vary, but it is essential that the roof as well as the sides of the incision be subjected to hydration.

OTHER FACTORS

Could factors other than wound architecture play a role in infection rates? Could any incisional method be responsible for a greater chance of intraoperative anterior chamber contamination? It is well established that the patient's periocular bacterial flora is the source of microbes in the usual sporadic case of bacterial endophthalmitis.[17] Careful draping of the eyelid margins in combination with chemoprophylactic antisepsis is likely to reduce the chance of anterior chamber contamination during surgery. Although no study has tested for a relationship between topical anesthesia and rates of infection, one might speculate that it is more difficult to adequately drape the lashes and lid margins when topical anesthesia is used. Because the eyelids are more difficult to control without orbicularis akinesia, draping efficacy may play a role in infection rates. Hence, having patients under injection anesthesia, with flaccid lids, might allow more effective draping and a reduced likelihood of intraoperative contamination. Topical anesthesia, therefore, might be an indirect cause of a greater risk for postoperative endophthalmitis, unless the surgeon develops a draping method specific and efficacious for that anesthetic method.

Another potential factor not directly related to the CCI itself relates to the contemporaneous shift toward temporal incision placement as surgeons began to favor clear corneal wound construction over scleral tunnels. By definition, in 50% of cases involving temporal CCIs, the side-port incisions will be located inferiorly. One must consider whether this modification might have some bearing on the potential for infection given the possibility that organisms and contaminants may pool in the inferior conjunctival fornix, with direct contact with the side-port entry site. One might further speculate that there is not enough attention directed toward the assessment and assurance of a watertight closure of the paracentesis incision at the conclusion of surgery.

PROPHYLAXIS

An important issue regarding the prevention of postoperative endophthalmitis is the use of intracameral antibiotic agents. There have been several reports of a decreased incidence of endophthalmitis after the use of dilute antibiotic agents in the irrigating solution. However, these reports were not prospective or controlled studies and were often the results of surveys. Recent work in Sweden has evaluated the use of an intracameral antibiotic agent (cefuroxime) at the conclusion of surgery. Preliminary studies[18,19] have shown that this regimen is not toxic and may help prevent endophthalmitis. This early evidence led to the formation of a study sponsored by the European Society of Cataract & Refractive Surgeons (ESCRS) evaluating antibiotic prophylaxis of endophthalmitis following cataract surgery.[20] This multinational, prospective study randomized patients to receive an intracameral injection of cefuroxime at the conclusion of the surgery or topical antibiotic treatment alone (levofloxacin). Early statistical analysis revealed a large difference between the 2 groups, and the recruitment was halted early.[21] The incidence of endophthalmitis in the treatment groups not receiving cefuroxime was almost 5 times as high as the rate observed in the groups receiving treatment. While the initial results of this study showed a clear beneficial effect of using intracameral cefuroxime after cataract surgery, the rate of endophthalmitis in the control group was much higher than the rate observed in other studies of endophthalmitis. The results of this study may help prompt a change in the prophylaxis of endophthalmitis in patients receiving clear cornea wounds following cataract surgery. Surgeons await the final results of this potentially groundbreaking study.

CONCLUSION

The plethora of recent reports regarding increased rates for postoperative infection calls attention to the need for rigid control of surgical asepsis, particularly in incision management. It is interesting to note, however, that some surgeons report no greater rate of infection using CCIs.[15,22] With appropriate use of aseptic methods, including careful draping, chemoprophylaxis, and, particularly, CCI design, construction, and sealing, risks for infection should be acceptably low.[23]

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